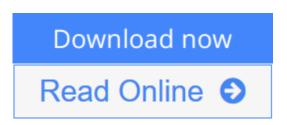# Automatic Differentiation in MATLAB Using ADMAT with Applications (Software, Environments and Tools)

By Thomas F. Coleman, Wei Xu

Automatic Differentiation in MATLAB Using ADMAT with Applications (Software, Environments and Tools) By Thomas F. Coleman, Wei Xu

The calculation of partial derivatives is a fundamental need in scientific computing. Automatic differentiation (AD) can be applied straightforwardly to obtain all necessary partial derivatives (usually first and, possibly, second derivatives) regardless of a code s complexity. However, the space and time efficiency of AD can be dramatically improved - sometimes transforming a problem from intractable to highly feasible - if inherent problem structure is used to apply AD in a judicious manner.

Automatic Differentiation in MATLAB using ADMAT with Applications discusses the efficient use of AD to solve real problems, especially multidimensional zero-finding and optimization, in the MATLAB environment. This book is concerned with the determination of the first and second derivatives in the context of solving scientific computing problems with an emphasis on optimization and solutions to nonlinear systems. The authors focus on the application rather than the implementation of AD, solve real nonlinear problems with high performance by exploiting the problem structure in the application of AD, and provide many easy to understand applications, examples, and MATLAB templates.

Audience: This book will prove useful to financial engineers, quantitative analysts, and researchers working with inverse problems, as well as to engineers and applied scientists in other fields.

Contents: Chapter 1: Fundamentals of Automatic Differentiation and the Use of ADMAT; Chapter 2: Products and Sparse Problems; Chapter 3: Using ADMAT with the MATLAB Optimization Toolbox; Chapter 4: Newton's Method and Optimization; Chapter 5: Structure; Chapter 6: Combining C/Fortran with ADMAT; Chapter 7: AD for Inverse Problems with an Application to Computational Finance; Chapter 8: A Template for Structured Problems; Chapter 9: R&D Directions; Appendix A: Installation of ADMAT; Appendix B: How Are Codes Differentiated?

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Editorial Review

About the Author
Thomas F. Coleman is Professor, Department of Combinatorics and Optimization and Ophelia Lazaridis University Research Chair, University of Waterloo. He is also the director of WatRISQ, an institute composed of finance researchers that spans several faculties at the university. From 2005 to 2010, Dr. Coleman was Dean of the Faculty of Mathematics, University of Waterloo. Prior to this, he was Professor of Computer Science, Cornell University. He was also the director of the Cornell Theory Center (CTC), a supercomputer applications center, and founded and directed CTC-Manhattan, a computational finance venture. Dr. Coleman has authored three books on computational mathematics, edited six conference proceedings, and published over 80 journal articles in the areas of optimization, automatic differentiation, parallel computing, computational finance, and optimization applications.

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